Abstract ID : 27

Title : Hydrodynamics of Dolphin Drafting

Category : Behavior

Student :

Preferred Format : Oral Presentation

Abstract : Hydrodynamics of Dolphin Drafting

Drafting in cetaceans is defined as the transfer of forces from one individual to another by hydrodynamic means, without actual physical contact between them. This behavior has long been surmised to be the means by which young dolphin calves keep up with their rapidly moving mothers and their herd cohort, but no clear understanding of the principles involved is to be found. This issue has recently gained importance as it has been observed that significant number of calves, separated from their mothers, end up being caught in tuna nets.

A study of the hydrodynamics of drafting, initiated in the hope of understanding the mechanisms of separation of mothers and calves during fishing activities, is reported here. A model of flow around a single, and a pair of unequally sized dolphin-like slender bodies is developed. This model allows the calculation of hydrodynamic interactions, showing that there are several distinct mechanisms for force transference. Quantitative results are shown for the forces and moments

First, the so-called Bernoulli suction, which stems from the fact that local pressure drops in areas of high speed, resulting in an attractive force between mother and calf. This force is large enough to result in cases of bolting, in which calves are sometimes detached fro their mother's side by a second, rapidly moving animal sweeping pas the pair.

Second, the displacement effect, in which the motion of the mother causes the water in front to move forwards and sideways, and waters behind the body again to move forward to replace the animal's mass. This results in the calf moving at lower velocity relative to the water mass as it moves in this flow-field, thus reducing the drag- which is proportional to the relative velocity squared. By proper placement of a newborn calf, it can gain up to 80% of the thrust needed to move alongside the mother at speeds of up to 5 knots.

Additional factors such as surface breaching, porpoising and avoidance of wake turbulence are also discussed, and a comparison to experimental data of Eastern Spinners is presented, showing savings of up to 60% in the thrust required of calves in keeping up, but also showing the drastic results of non-optimal behavior, when a calf drops behind by an inefficient leap.